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OOAMA

AIRMUNITIONS TEST REPORT

DISPOSAL TESTS

for

AIR-2A "GENIE" ROCKET MOTORS

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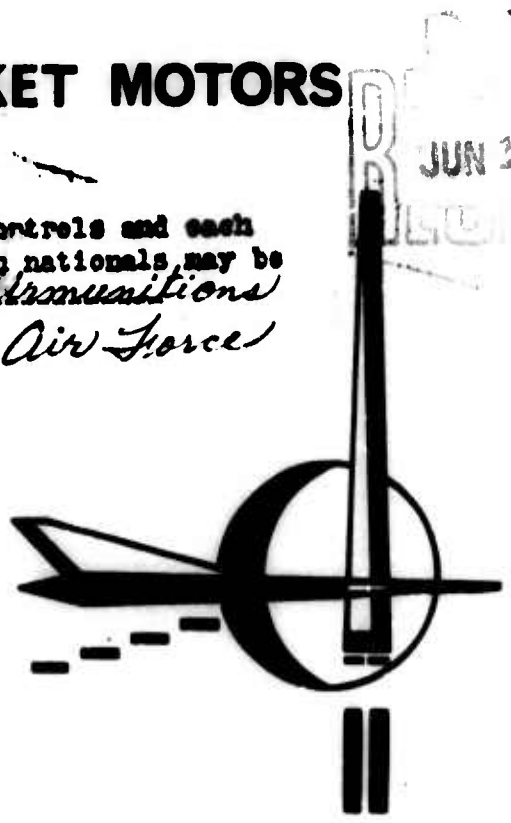

SERVICE ENGINEERING DIVISION

2705th Airmunitions Wing

Hill AF Base, Utah 84401

DISPOSAL TESTS

FOR

AIR-2A "GENIE" ROCKET MOTORS

BY
H. K. Porter

PUBLICATION REVIEW
This report has been reviewed and approved

HENRY J. KEYES
Chief, Aircraft & Accy Branch
2705th Airmunitions Wing

DATE
April 1968

2705th Airmunitions Wing
Ogden Air Materiel Area
Air Force Logistics Command
United States Air Force
Hill AFB, Utah

NOTICES

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The conclusions and recommendations made in this report are not to be considered directive in nature. This type information becomes official only when published in Technical Orders or other applicable Air Force publications.

Qualified requesters may obtain a copy of this report from the Defense Document Center, Cameron Station, Alexandria, Virginia, 22314.

ADMINISTRATIVE DATA

PURPOSE OF TEST:

This test was conducted to determine if a safe method for disposing of AIR-2A "Genie" Rocket Motors could be devised.

MANUFACTURER'S:

Aerojet General Corporation
Sacramento, California 95810

McDonnell Douglas Corporation
3000 Ocean Park Blvd
Santa Monica,California 90405

MANUFACTURER'S PART NUMBER:

5685242-511 Rocket Motor

3-318800 Rocket Motor (No flight hardware)

DRAWINGS AND SPECIFICATIONS:

McDonnell Douglas Corporation

5685242 - Rocket Motor

7685255 - Rocket Motor, Model MB-1 (U), General Requirements Specification

7836363 - Rocket Motor - Specification Control Drawings

Aerojet General Corporation

3-318800 - Rocket Motor

3-318795 - Chamber Assy, Riveted

3-318799 - Chamber and Grain Assy, Rocket Motor

3-035529 - Aft Closure and Exit Cone Assy

3-014124 - Cone, Exit

3-038887 - Closure Assy, Aft (Final)

3-03885 - Closure, Aft Insulated

SECURITY CLASSIFICATION:

Unclassified

DATE TEST COMPLETED:

January 1967

TEST CONDUCTED BY:

OOAMA (OOY-2705th Airmuntions Wing)

Test Director: Sidney M. Jacobs, Lt Col USAF (OOYT)

Project Engineer: Harry K. Porter, Mechanical Engineer (OOYEA)

ABSTRACT

These tests were conducted to determine a safe method by which Field Activities could dispose of Air-2A "Genie" Rocket Motors.

Six each rocket motors were tested by six separate methods to determine the most efficient and safest disposal method. The desired result was a method which would vent the case, without scattering propellant over a large area or detonating it. The results of these tests showed that venting the case was an unreliable and unsafe method to use in disposing of motors. Each method that relied on destruction of the motor case (P/N 3-318795) produced detonations which scattered propellant and/or metal shrapnel over a large area.

The most successful method tested was removing the exit cone (P/N 3-014124) from the rocket motor, burying the rocket motor vertically (36-48 inches deep) then static firing it with an MXU-35/A igniter or MA-1 igniter. This is the only recommended method for disposing of Genie Rocket Motors.

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INTRODUCTION

All explosive items have a definite shelf/service life which is limited to some portion of the time from the explosive's manufacture date until the time it becomes unreliable or unsafe. The shelf/service life is a distinct time period which has been determined through complex tests conducted by the Air Force or the contractor. Explosive items which have exceeded their shelf lives cannot be used and therefore must be disposed of by some means. The currently established shelf/service life for the AIR-2A "Genie" Rocket Motor is 27 months.

The data presented herein was obtained by testing six separate disposal methods. It was recognized that numerous other possible disposal methods existed but cost and available assets limited the test to six methods. The tests were conducted under the provisions of Test Directive No C-6-342-A, issued 7 September 1966 by the Aircraft & Accessories Branch (OOYEA), Service Engineering Division, 2705th Airmunitions Wing. The tests were performed by the 2727th Test Squadron (OOYT), 2705th Airmunitions Wing.

DESCRIPTION

The AIR-2A "Genie" Rocket is a nuclear tipped rocket used on the F-89/J, F-101/B and F-106 Aircraft. The rocket is composed of four major components; the A/A44A-1A Rocket Motor, the Mk-25 Mod 0 Nuclear Warhead, the MXU-35/A (or MA-1) Igniter and the MA-1A Firing Mechanism. The A/A44A-1A Rocket Motor and MA-1 Igniter were the only items used in these tests. The A/A44A-1A Rocket Motor is composed of a motor case, electrical harness, pressure actuated fins, aft closure and exit cone assembly and a solid propellant grain. The grain configuration is a complex twelve point star configuration and is bonded to the motor case. The complete motor weighs approximately 500 pounds with the propellant grain comprising 328 pounds of this weight. The MA-1 igniter is a pyrotechnic unit weighing approximately 3.25 pounds and is composed of an adapter, basket assembly, four squibs, and the explosive charge. The squibs are electrically initiated.

EQUIPMENT

The following equipment was used to conduct these tests.

1. Flexible Linear Shaped Charge-Jet-Cord, Explosive Technology Inc., Type RL-150-J, P/N 40347 (150 GR/FT, RDX).

2. Detonating Cord, (Prima-Cord), Ensign-Bickford Co., Type IV, Class E, 60 GR/FT RDX.

3. Blasting Caps, Type E-81, FSN 1375-839-8257

4. Portable Power Supply

5. C-6 Still Cameras

6. Fastax Movie Cameras

7. Bell & Howell Movie Camera

TEST PROCEDURES

Six separate methods for disposing of rocket motors were evaluated in this test. The Procedures used to conduct the tests are outlined below:

Test Number 1:

The rocket motor was partially disassembled by removing the fin assemblies, motor electrical assembly and the launch lugs. Flexible linear shaped charge (FLSC) was placed on the motor, over the heater blanket, as shown in Figure 1. The motor was placed in a 3 foot deep hole behind a dirt barricade (see Fig 7) and the FLSC was initiated with a type E-81 blasting cap.

Test Number 2:

The rocket motor was partially disassembled by removing the fin assemblies, heater blanket, motor electrical assembly and the launch lugs. Detonating cord (prima cord) was assembled into a simulated linear shaped charge as shown in Figure 3. This was accomplished by bonding the detonating cord onto cardboard bent into a 90° angle. The detonating cord assembly was placed on the motor as shown in Figure 2 with cloth backed tape. The motor was placed in a 3 foot deep hole behind a dirt barricade (see Figure 7) and the detonating cord assembly was initiated with a type E-81 blasting cap.

Test Number 3:

The rocket motor was partially disassembled by removing the fin assemblies, heater blanket, motor electrical assembly and launch lugs. A detonating cord assembly was placed on the motor as shown in Figure 4 with cloth backed tape. The motor was placed in a 3 foot deep hole behind a dirt barricade (see Figure 7) and the detonating cord was initiated with a type E-81 blasting cap.

Test Number 4:

The rocket motor was partially disassembled by removing the fin assemblies, heater blanket, the motor electrical assembly, and the launch lugs. A detonating cord assembly was placed on the motor as shown in Figure 5 with cloth backed tape. The motor was placed on a 3 foot deep hole behind a dirt barricade (see Figure 7) and the detonating cord was initiated with a type E-81 blasting cap.

Test Number 5:

The rocket motor was partially disassembled by removing the fin assemblies, heater blanket, motor electrical assembly, and the launch lugs. An MA-1 igniter, with a modified electrical cable lead, was installed in the motor. The modified cable was routed to the rear along the motor case and taped in position. The motor was buried vertically up to the aft closure (see Figure 6) and the dirt was tamped firmly in place. The igniter leads were connected to a power supply and an electrical current was supplied to fire the igniter.

Test Number 6:

The rocket motor was partially disassembled by removing the fin assemblies, heater blankets, motor electrical assembly, the launch lugs, and exit cone (P/N 3-014124). An MA-1 igniter with a modified electrical cable lead was installed in the motor. The modified cable was routed to the rear along the motor case and taped on position. The motor was buried vertically up to the aft closure (see Figure 6) and the dirt was tamped firmly in place. The igniter leads were connected to a power supply and an electrical current was supplied to fire the igniter.

TEST RESULTS

Test Number 1:

A large explosion followed by several smaller explosions occured immediately after initiation of the flexible linear shaped charge (FLSC). The FLSC ignited the propellant and scattered it over a large area. Photo coverage showed the burning pieces were thrown 40-70 feet above the hole in which the motor was placed. The forward dome, which was severed from the motor case, was also ejected to a height of approximately 50 feet. Several pieces of unburned propellant, and a portion of FLSC were also found scattered throughout the area. The forward dome was located approximately 300 feet from the test site, the propellant was randomly dispersed up to approximately 300 feet from the test site and the FLSC was located approximately 5 feet from the hole in which the motor was placed. A post test examination of the rocket motor showed that the forward charge was the only charge to sever the motor case; the longitudinal FLSC charge, though detonated, did not split the case and the Aft FLSC charge failed to initiate and was ejected from the hole. (See Figures 8 through 11)

Test Number 2:

The detonating cord assembly detonated with such force that approximately one-third of the rocket motor propellant grain was vertically ejected to a height of 40-90 feet. The propellant did not ignite and was scattered within 100 feet of the test area. There was no evidence of burning propellant being ejected from the hole in which the motor was placed. A post test examination of the rocket motor showed that the detonating cord assembly severed the motor longitudinally, at the forward dome and at the aft end. The remaining two-thirds of the propellant that was not ejected was ignited by the detonating cord assembly and burned at the test site. (See Figures 12 through 14)

Test Number 3:

The detonating cord assembly, when initiated, caused only superficial damage to the rocket motor. It did not sever the aft end of the motor case as intended, nor did it cause initiation of the propellant. The rocket motor was indented to a depth on one-sixteenth inch along the entire circumference of the aft end of the case by the blast from the detonating cord assembly. The rocket motor was subsequently destroyed by E.O.D. Personnel. (See Figures 15 and 16)

Test Number 4:

The detonating cord assembly, when initiated, caused only superficial damage to the rocket motor. It did not sever the aft end of the motor case or split it longitudinally as intended. The propellant also was not initiated by the explosion of the detonating cord. The rocket motor was indented along the aft end of the case and longitudinally to a depth of three-sixteenths inch by the blast from the detonating cord assembly. (See Figures 17 and 18)

Test Number 5:

The rocket motor, upon ignition, immediately began to burrow into the ground. The hole dug by the rocket motor was approximately three feet in diameter and 30-50 feet deep. The rocket motor was not visible in the hole after firing. The position of the debris (dirt, mud, etc) ejected by the rocket motor indicate that the motor traveled at some angle after entering the ground. There were no abnormal sounds heard during the firing to indicate that the rocket motor case failed. There was no attempt made to recover the expended rocket motor case. (See Figures 19 and 20)

Test Number 6:

The rocket motor remained almost stationary throughout the duration of this test. Examination of the area before and after the test showed that the rocket advanced only about two inches vertically. A post firing analysis of the motor case showed that the graphite nozzle insert was ejected during the firing. The time at which this occurred could not be ascertained from the motion pictures taken of the firings. The only other abnormality noted was a long duration time (burn time) due to the decrease in chamber pressure that occurred when the nozzle exit diameter was increased (See Figures 21 and 22).

RECOMMENDATIONS

It is recommended that the following procedures be used to dispose of AIR-2A "Genie" Rocket Motors:

1. Partially disassemble the rocket motor by removing the fin assemblies, heater blanket, motor electrical assembly and the exit cone (P/N 3-014124).

2. Install an MA-1 igniter (or MXU-35/A igniter) with leads sufficiently long to reach the end of the motor case. Tape the igniter lead to the motor case.

3. Bury the motor vertically up to the aft closure (36-48 inches). Tamp the dirt firmly around the rocket motor.

4. Initate the igniter by some suitable means. The personnel who perform this step should be protected by suitable barricades remotely located.

CONCLUSIONS

The safest and most satisfactory method of disposing of Genie Motors is to remove the exit cone (P/N 3-014124), install an MA-1 igniter (or MXU-35/A igniter), bury the motor and fire it (Test Method Number 6).

The various methods (Test Methods 1 through 4) of disposing of the rocket motor by venting the motor case all proved to be unsatisfactory as they were unreliable (i.e. partial detonation or not opening the motor case) and unsafe. Disposal methods of this type scatter debris throughout the test area thus creating a hazard to personnel and property. Therefore methods of this nature should not be attempted except in extreme emergencies.

The method of burying the rocket motor and firing it with the exit cone installed also should not be used. The thrust developed by the motor is sufficient to propel the rocket motor into the ground and if an obstacle is encountered the motor's direction of travel can be altered in such a manner that the rocket motor becomes airborne. The rocket motor could travel several miles if this occurred during early rocket burning.

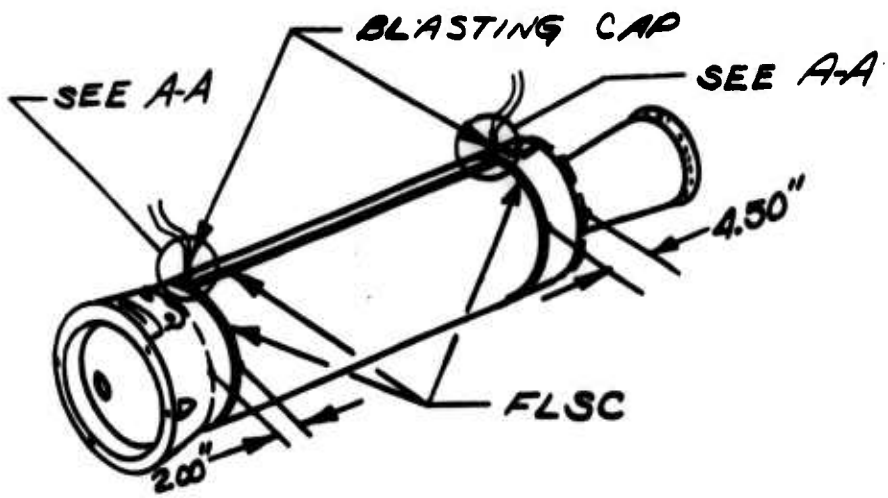
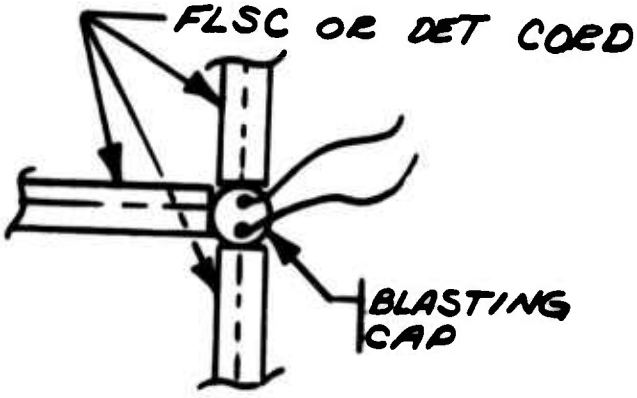


FIGURE 1: A SKETCH SHOWING THE POSITION OF THE FLEXIBLE LINEAR SHAPED CHARGE FOR TEST 1.



SECTION A-A: A SKETCH SHOWING THE POSITION OF THE BLASTING CAP USED TO INITIATE DETONATING CORD OR FLSC.

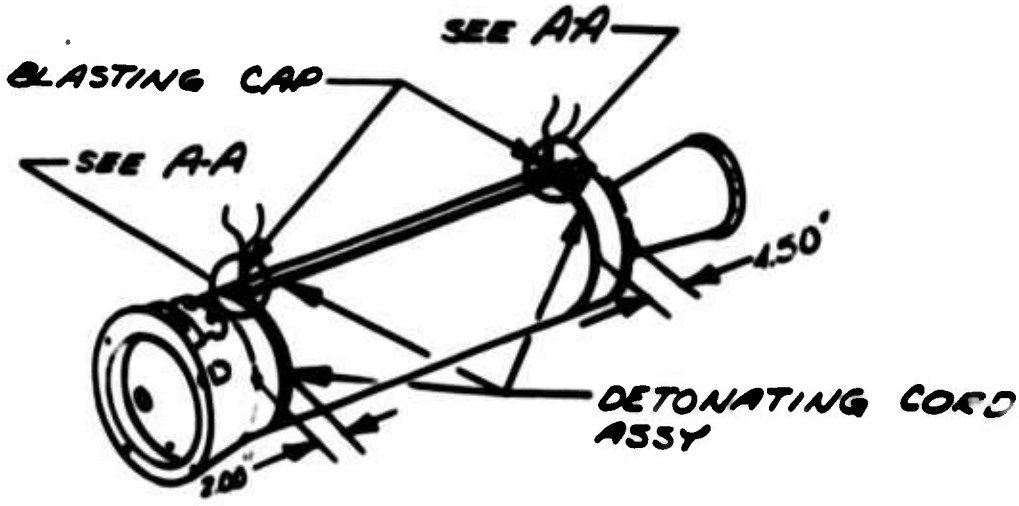


FIGURE 2: A SKETCH SHOWING THE POSITION OF THE DETONATING CORD ASSEMBLY FOR TEST 2.

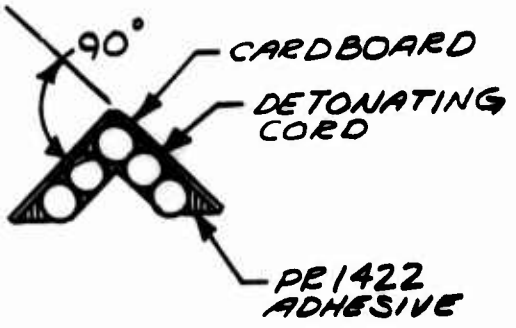


FIGURE 3: A SKETCH SHOWING THE CROSS-SECTIONAL CONFIGURATION OF ALL DETONATING CORD ASSEMBLIES.

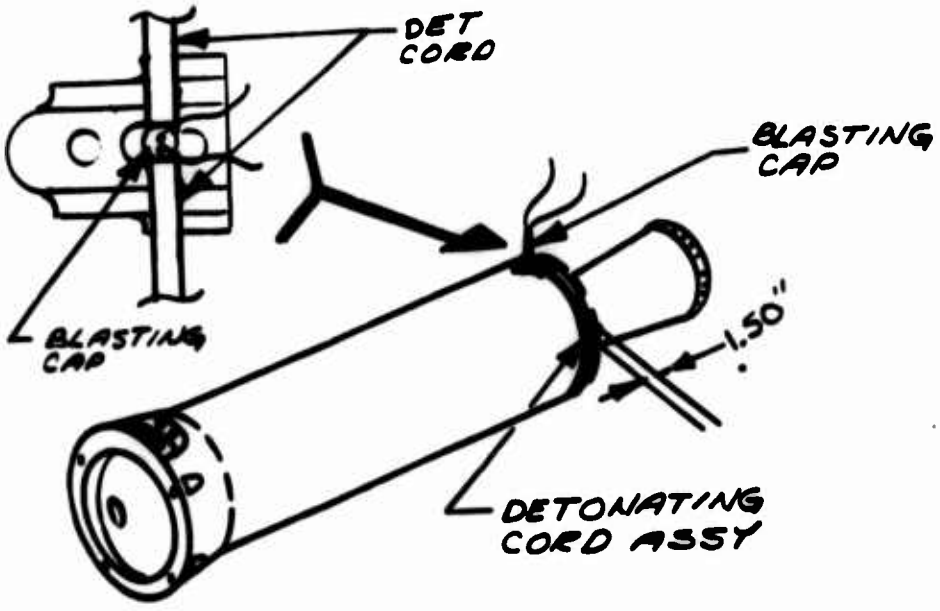


FIGURE 4: A SKETCH SHOWING THE POSITION OF THE DETONATING CORD ASSEMBLY FOR TEST 3.

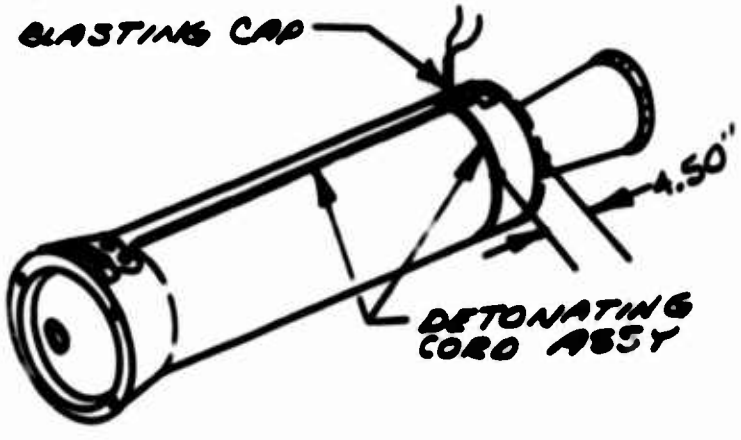


FIGURE 5: A SKETCH SHOWING THE POSITION OF THE DETONATING CORD ASSEMBLY FOR TEST 4.

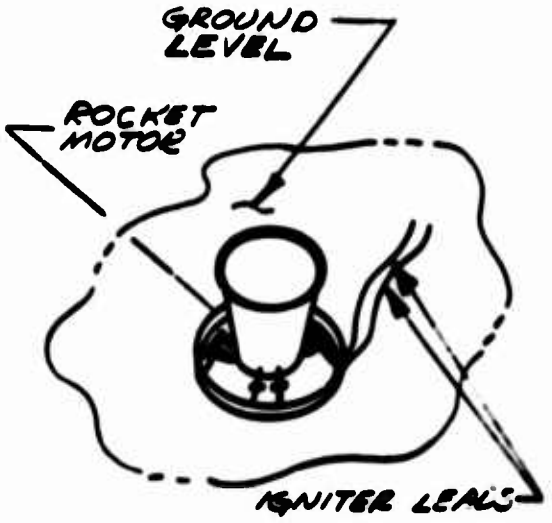


FIGURE 6: A SKETCH SHOWING THE TEST SET UP FOR TESTS 5 AND 6.

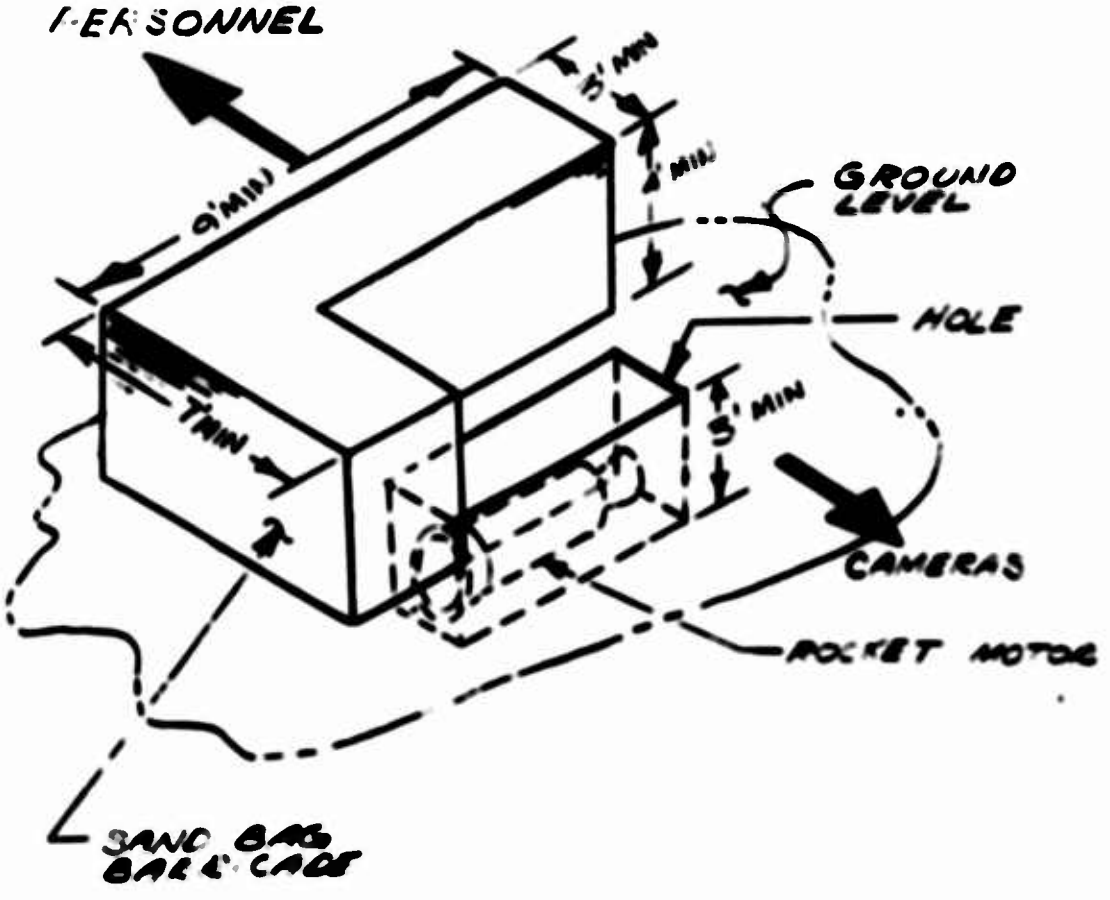


FIGURE 7: A SKETCH SHOWING THE POSITION OF THE MOTORS DURING TESTS 1 THROUGH 4.

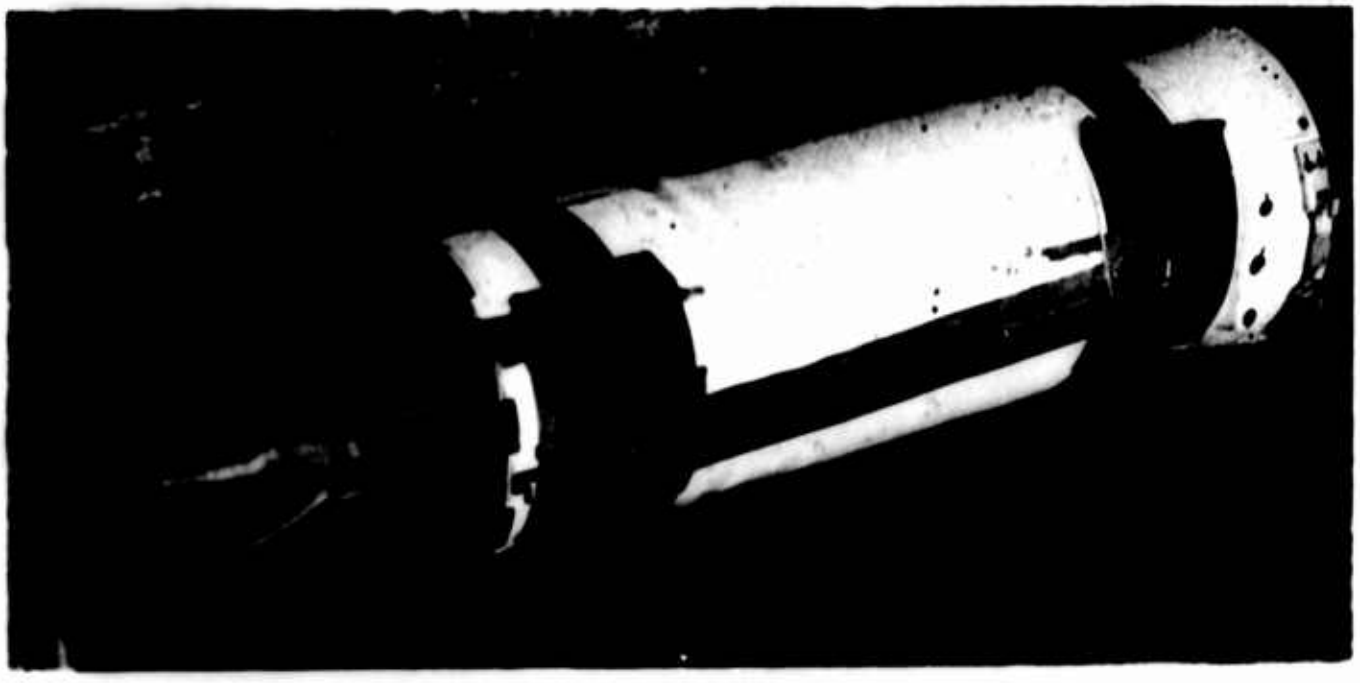


FIGURE 8: A PHOTOGRAPH OF THE FLEXIBLE LINEAR SHAPED CHARGE INSTALLATION FOR TEST 1.

FIGURE 9: A PHOTOGRAPH OF THE PORTION OF FLEXIBLE LINEAR SHAPED CHARGE NOT INITIATED IN TEST 1.

FIGURE 10: THE REMAINS OF THE ROCKET MOTOR AFTER INITIATION OF THE FLEXIBLE LINEAR SHAPED CHARGE. (TEST 1)

FIGURE 11: THE REMAINS OF THE ROCKET MOTOR AFTER INITIATION OF THE FLEXIBLE LINEAR SHAPED CHARGE. (TEST 1)

FIGURE 12: A PHOTOGRAPH OF THE UNBURNED PROPELLANT EJECTED DURING TEST 2.

FIGURE 13: THE REMAINS OF THE ROCKET MOTOR AFTER INITIATION OF THE DETONATING CORD ASSEMBLY. (TEST 2)

FIGURE 14: THE REMAINS OF THE ROCKET [illegible] ASSEMBLY. (TEST 2)

FIGURE 15: A PHOTOGRAPH OF THE DETONATING CORD INSTALLATION FOR TEST 3.

FIGURE 16: THE REMAINS OF THE MOTOR AFTER INITIATION OF THE DETONATING CORD. (TEST 3)

FIGURE 17: THE REMAINS OF THE ROCKET MOTOR AFTER INITIATION OF THE DETONATING CORD. (TEST 4)

FIGURE 18: THE REMAINS OF THE ROCKET MOTOR AFTER INITIATION OF THE DETONATING CORD. (TEST 4)

FIGURE 19: THE POSITION OF THE ROCKET MOTOR PRIOR TO FIRING. (TEST 5)

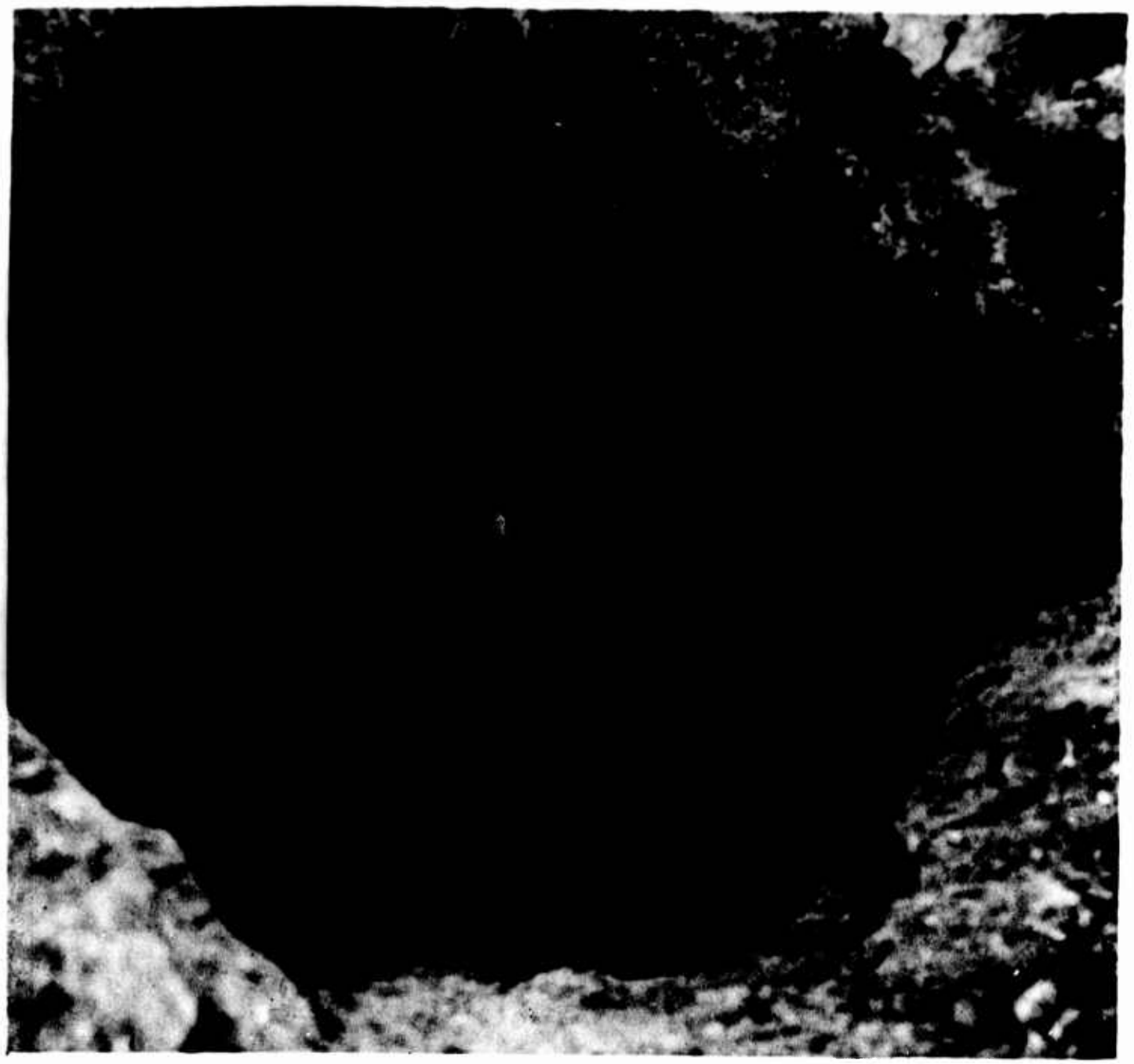


FIGURE 20: THE CRATER LEFT BY THE ROCKET MOTOR. (TEST 5)

FIGURE 21: THE POSITION OF THE ROCKET MOTOR PRIOR TO FIRING. (TEST 6)

FIGURE 22: THE POSITION OF THE ROCKET MOTOR AFTER FIRING. (TEST 6)